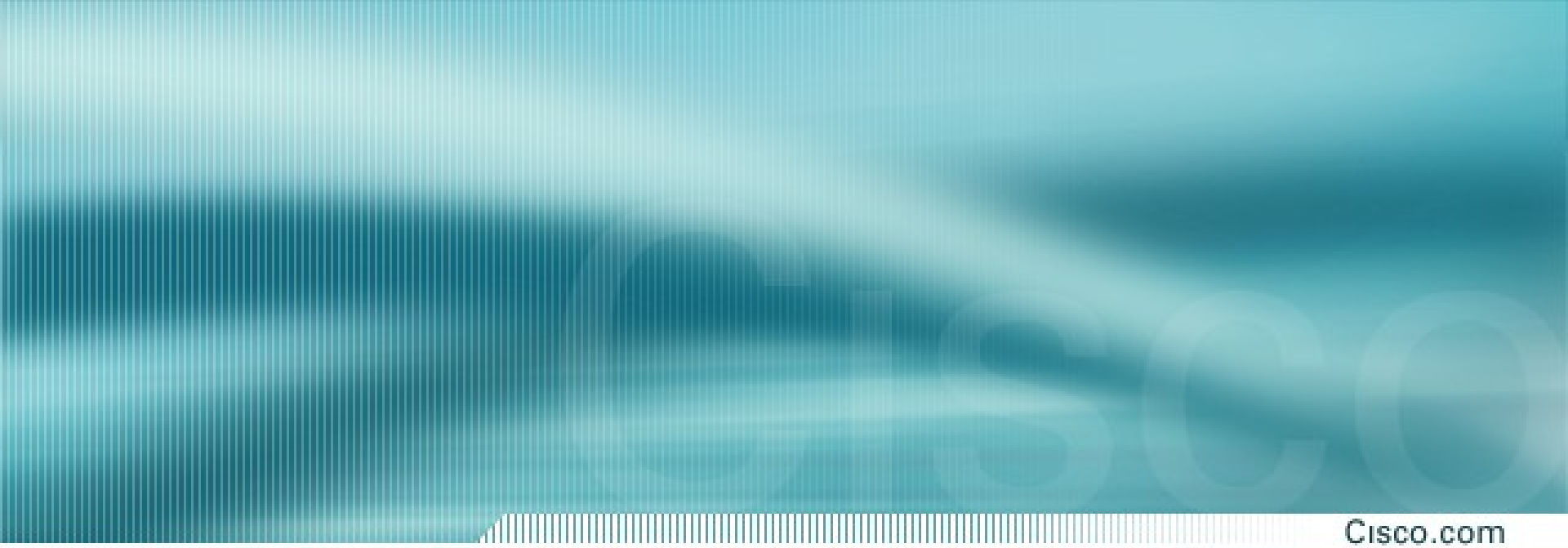

WAN Connectivity Options and Performance Troubleshooting Tools

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Agenda

- **WAN Media**
- **Management / Measurement**

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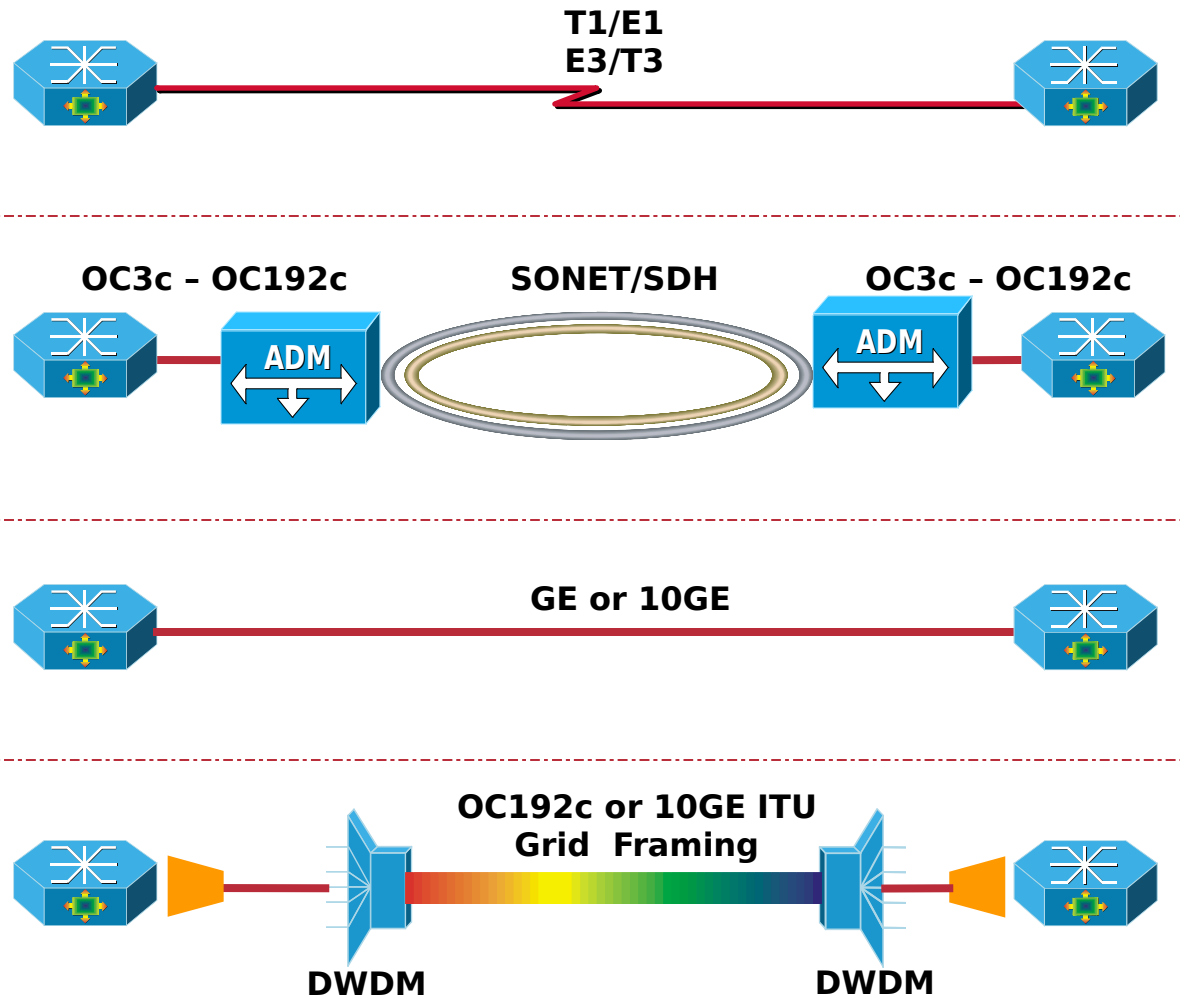
WAN Media



LAN	WAN
	T1 1.5Mbps E1 2Mbps
10Mbps	
	E3 34Mbps T3 45Mbps
100Mbps	
	OC3c / STM1 155Mbps
	OC12c / STM4 622Mbps
1Gbps	
	OC48c / STM16 2.4 Gbps
10Gbps	OC192c / STM64 9.8Gbps
	OC768 / STM256 40Gbps

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Measurement / Management

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Two classes of problems

Need Real Time Information to Solve

- Can not access xyz application
- Can not access the Internet

Need Historical Information and Real Time Information to Solve

- Access to my email is slow again, it was slow last week at this time
- Access to the Internet is slow, it has been slow for the past two days but it is ok now

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Performance Troubleshooting

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Network Performance Problem - Example

- Clients complaining that access to application is slow
- It was ok last week but is now extremely slow to access email this morning
- Access to the Internet is periodically slow
- Are these Network Problems or Application Problems?

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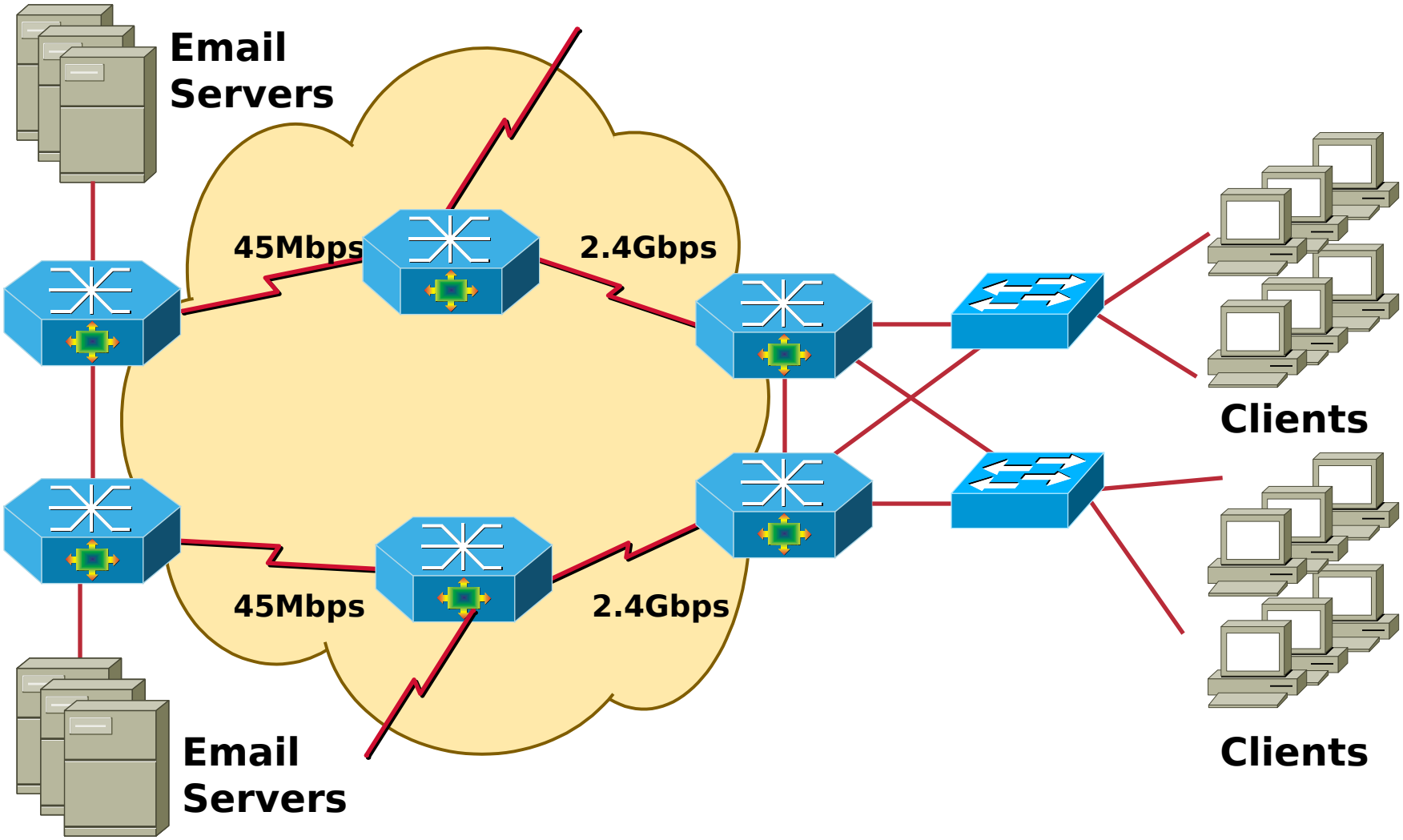
Network Diagram



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What is the problem?

- **Insufficient WAN bandwidth?**
- **Latency the WAN links introducing?**
- **The location of the servers?**

Impossible to determine without more information

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What steps do you take in troubleshooting performance problems?

1. Determine the source and destination of the traffic
2. Look at the utilization of the server
3. Determine the path the traffic is taking between the source and destination
4. Look at the links in the path to determine the utilization
5. Look at the nodes (switches / routers) to see if there are problems
6. Take a trace to look at the traffic flows involved

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Real Time Troubleshooting

- **Now the problem is identified, it can be solved**
- **What this does not answer is: "What changed between this morning and last week?"**
- **Historical information is required to answer this question, but none exists, so you are left to speculate as to reasons Why?**

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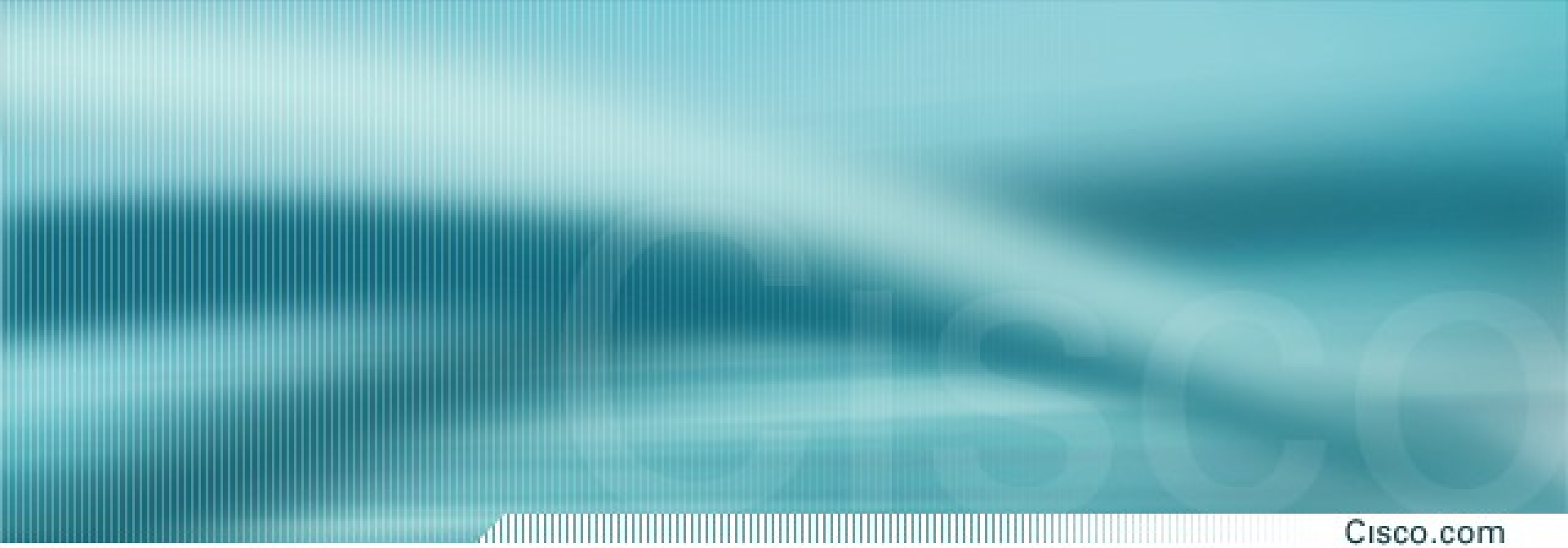

Network Measurement

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Baseline

- **Effective troubleshooting of the performance problems can only be achieved by having a baseline**
- **Peoples perception that something is slow, is not a quantifiable measurement**
- **Example:**

  Users complaining that access to email is slow after they were moved sites (Microsoft Exchange Server)

  Network Problem or Application Problem?

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Traps for young players

- **Grabbing a network management tool and installing it, without thinking about the information you need to solve common problems**
- **Thinking one tool does everything**

  “When you have a hammer everything looks like nail”

- **Tools do not replace troubleshooting skills and training of the network operations staff**

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What information did you just collect?

- **Host performance information**
- **Reachability**
- **Path Information**
- **Performance and Error information of interfaces**
- **Performance and Error information at the system level**
- **Protocol mix, packet size, session level response times**

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Features on switches and routers allow you to collect this information proactively

- **System Assurance Agent**

  Reachability, Path information, Response Time to hosts

- **SNMP MIBs**

  Interface utilization, drops, errors

- **Netflow, NBAR, SPAN, Capture features**

  Protocol mix, packet size, session information

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SNMP MIBs

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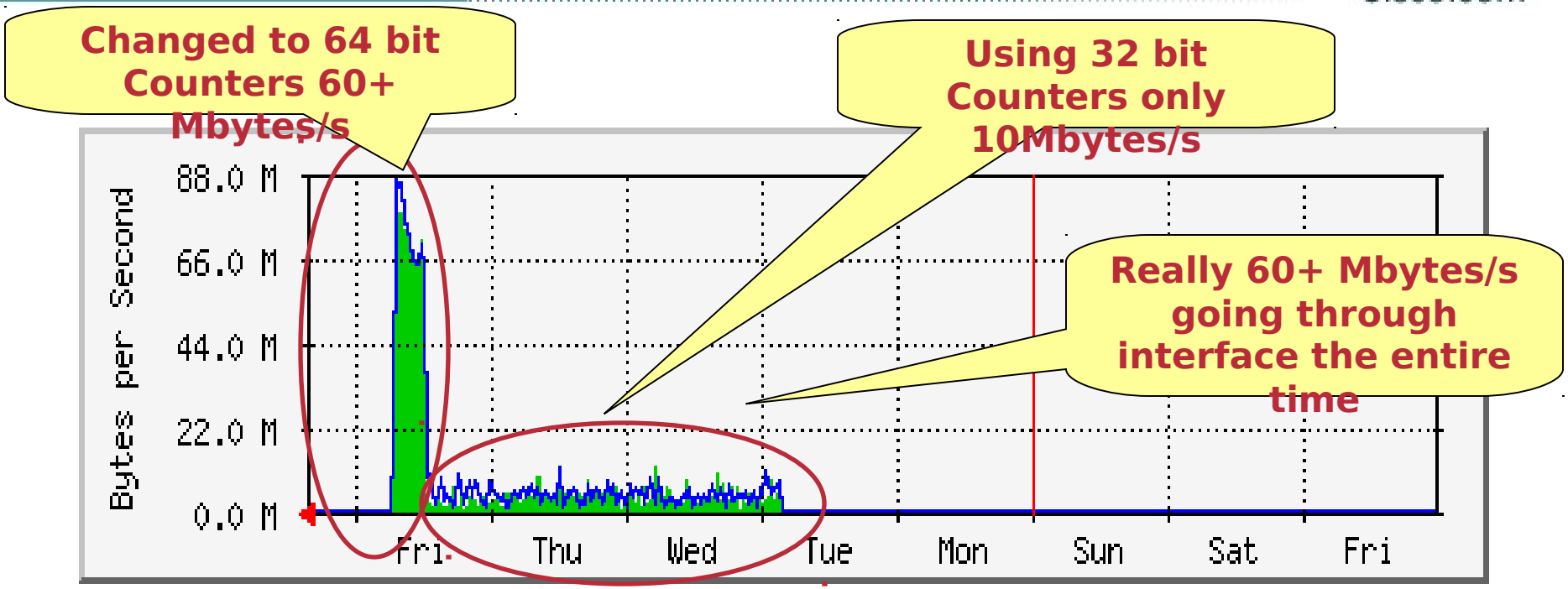
Use appropriate size counters
GIGO – Garbage In, Garbage Out



Used 32 bit counters instead of 64 bit counters on interfaces faster than 100Mbps, otherwise with high data rates and 5 minute polling interval you have counter wrap problems

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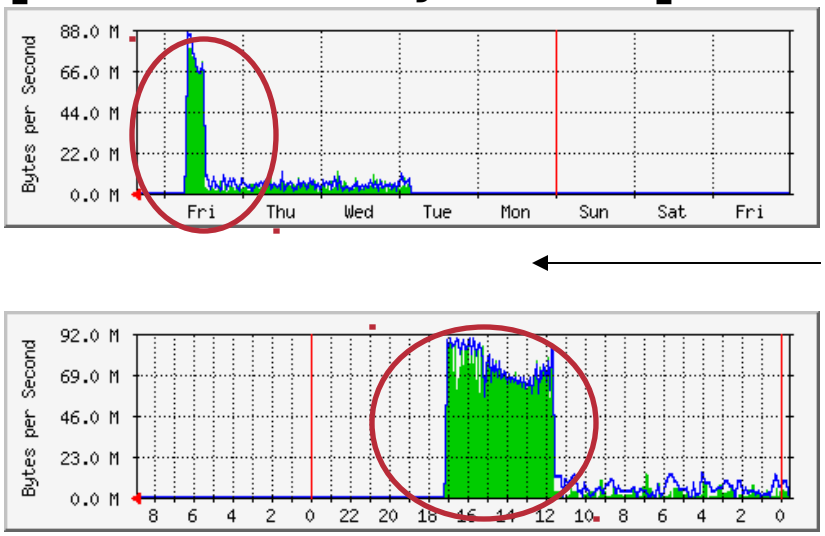
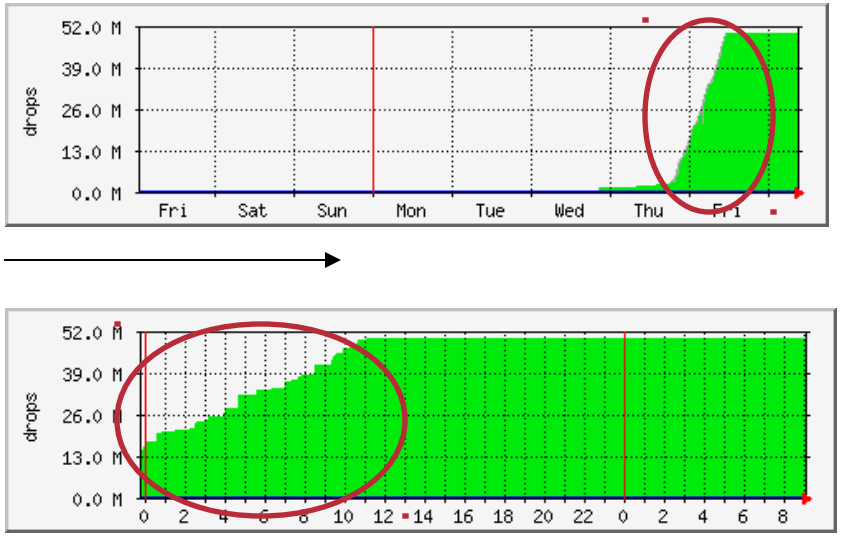
Interface utilization is not enough to determine performance problems

Interface Bytes In / Out



Interface Drops In / Out



raph shows link is not fully utilized (30%)
ax Performance of link 300MBytes (STM16)

Why would there be a performance problem when the link is not being fully utilized?

Need other information from the interface, like input and output drops

The performance problem coincides with a increase on the number of drops on the interface

What would cause an interface to drop traffic on output?

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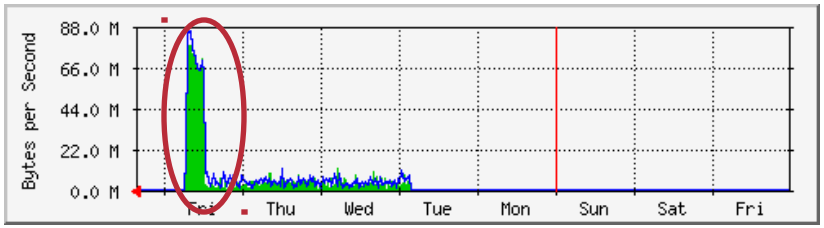
Interface utilization is not enough to determine performance problems (cont.)

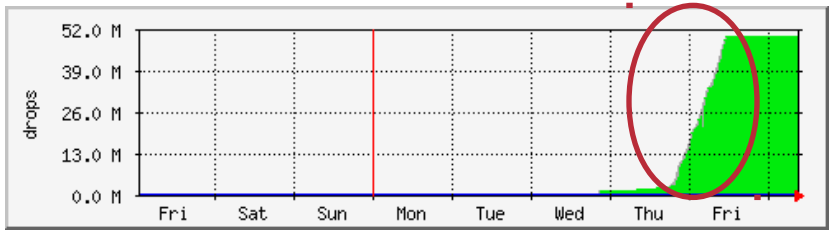
Facts

- 5 minute average byte rate 80Mbytes/s, only 30% utilization of the link
- Large number of packet drops, increasing the entire time performance problem was happening
- 5 minute average packet per second rate, 1.6Mpps
- 80Mbytes / 1.6M ~55 byte packets – Lot of small packets on the link

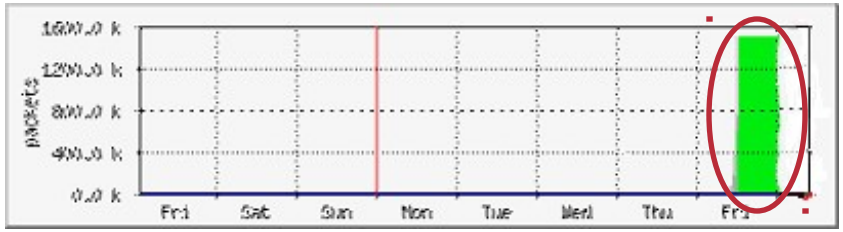
Interface Bytes In / Out



Interface Drops In / Out



Interface Pkts In / Out



ossible Denial of Service Attack occurrin

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SNMP MIB information used

- **ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInOctets (.1.3.6.1.2.1.31.1.1.1.6.<ifindex>)**
- **ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutOctets (.1.3.6.1.2.1.31.1.1.1.10.<ifindex>)**
- **ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInUcastPkts (.1.3.6.1.2.1.31.1.1.1.7.<ifindex>)**
- **ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutUcastPkts (.1.3.6.1.2.1.31.1.1.1.11.<ifindex>)**
- **interfaces.ifTable.ifEntry.ifInDiscards (.1.3.6.1.2.1.2.2.1.13.<ifindex>)**
- **interfaces.ifTable.ifEntry.ifOutDiscards. (.1.3.6.1.2.1.2.2.1.19.<ifindex>)**

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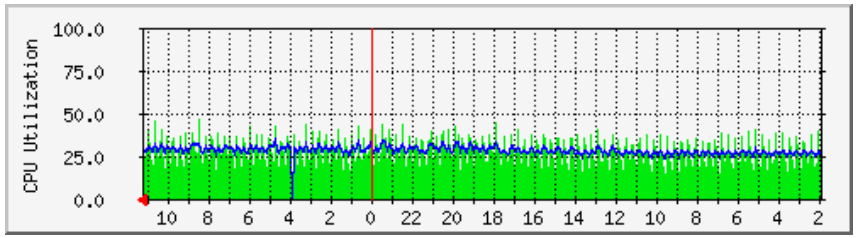
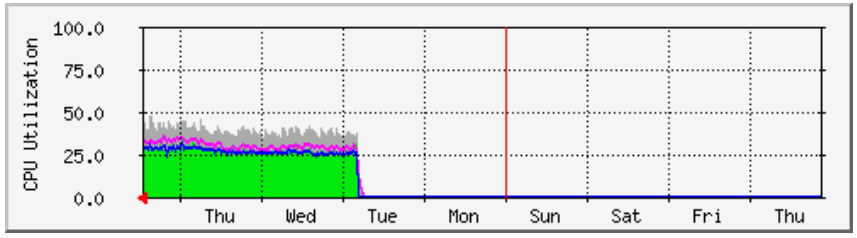
System CPU utilization

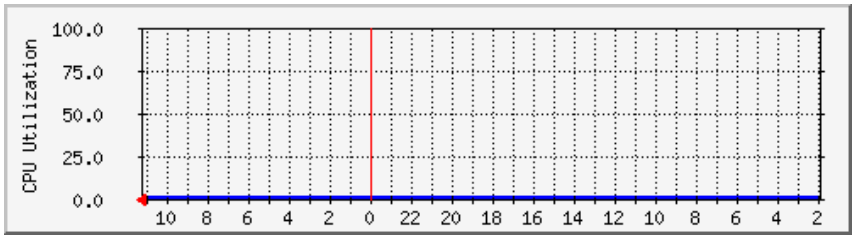
Cisco.com

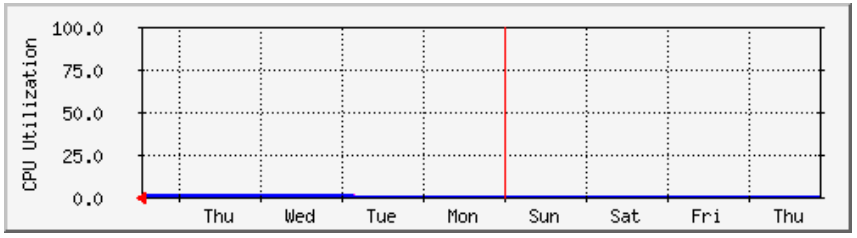
CPU Utilization This Week





CPU Utilization Last Week





Last week the CPU on the system was 0-2%. This week since Tuesday it has been running at 25%, Why?

SNMP avg busy 1 minute (.1.3.6.1.4.1.9.2.1.57.0
avg busy 5 minute (1.3.6.1.4.1.9.2.1.58.0)

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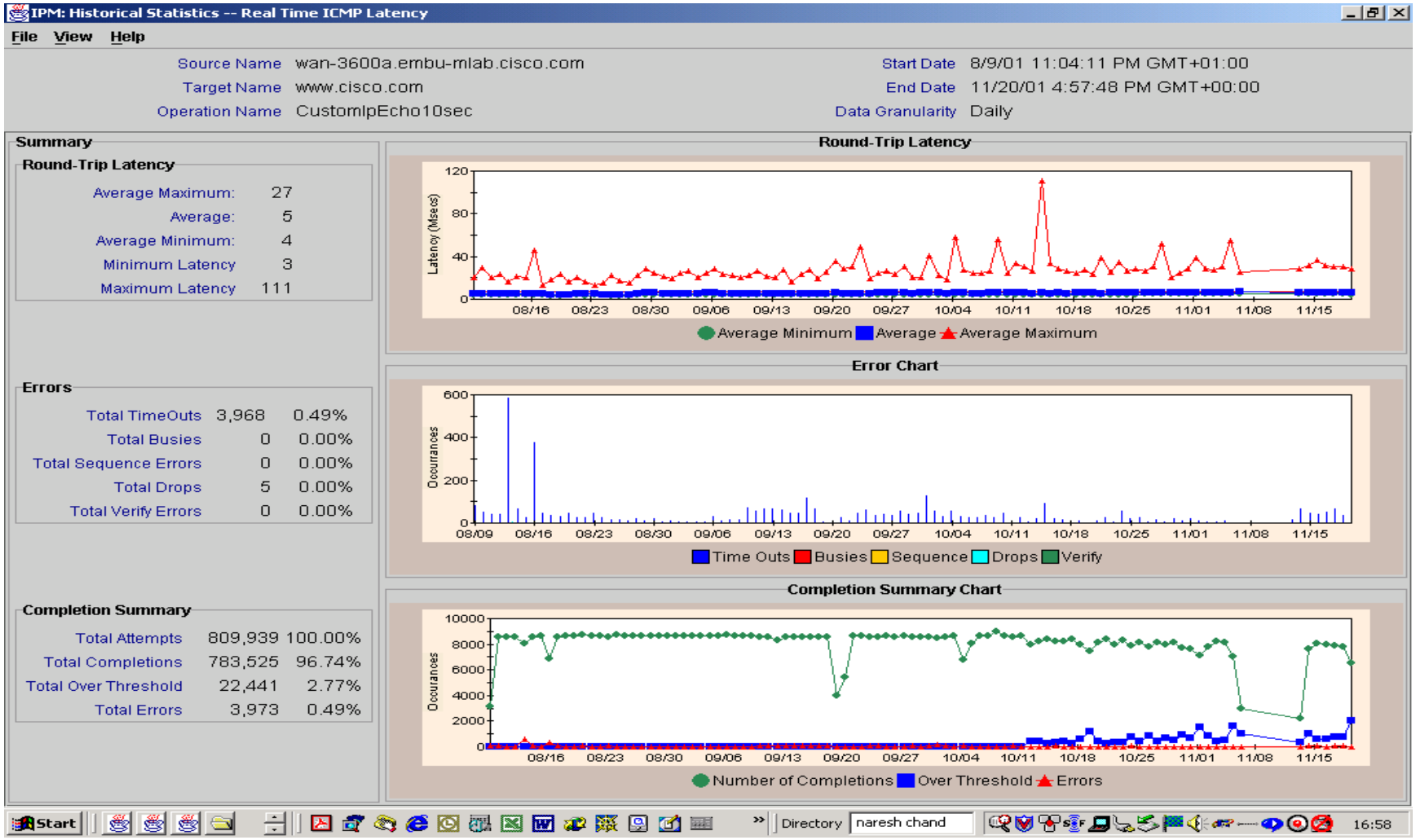
Latency measurement



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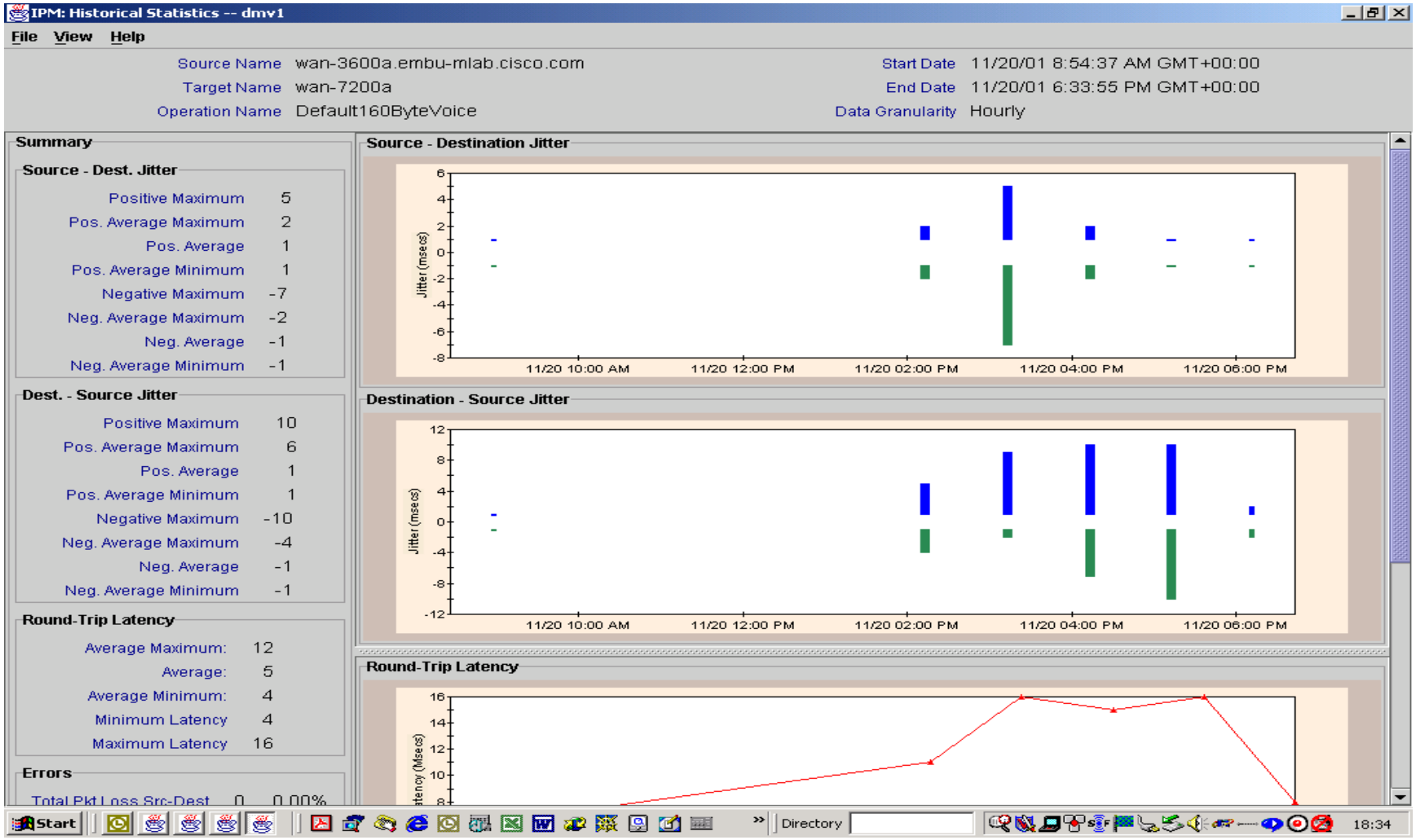
Jitter measurement



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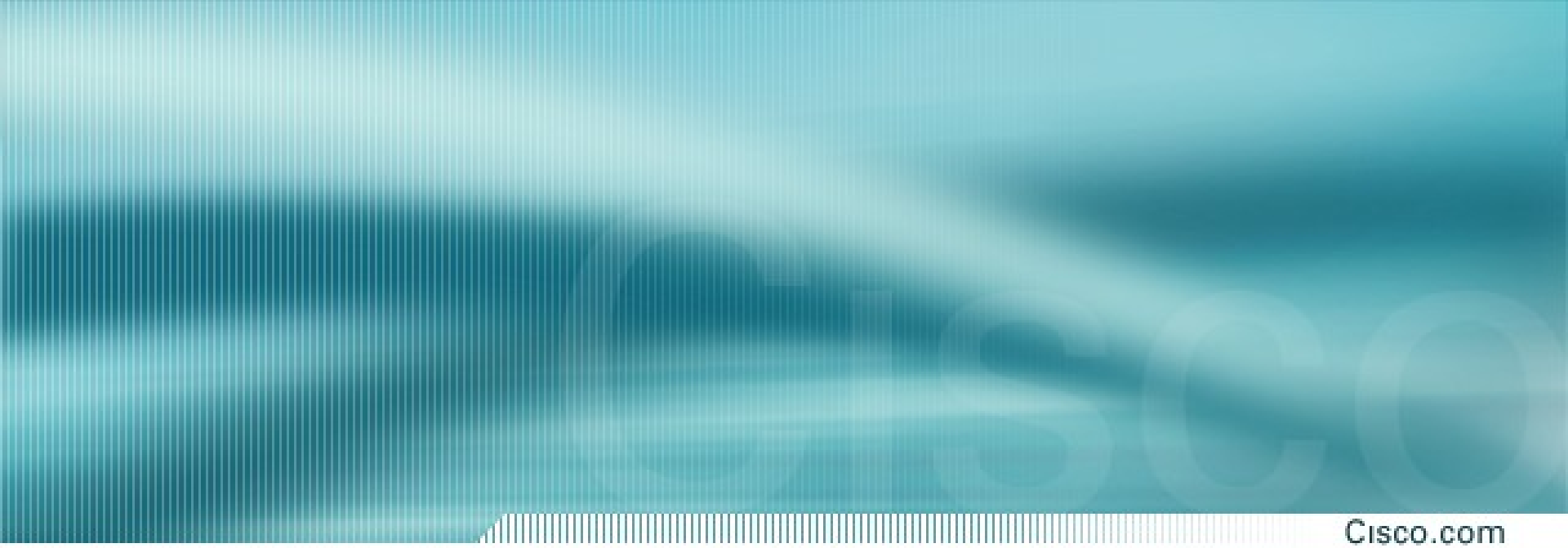

Netflow, Packet Capture Methods

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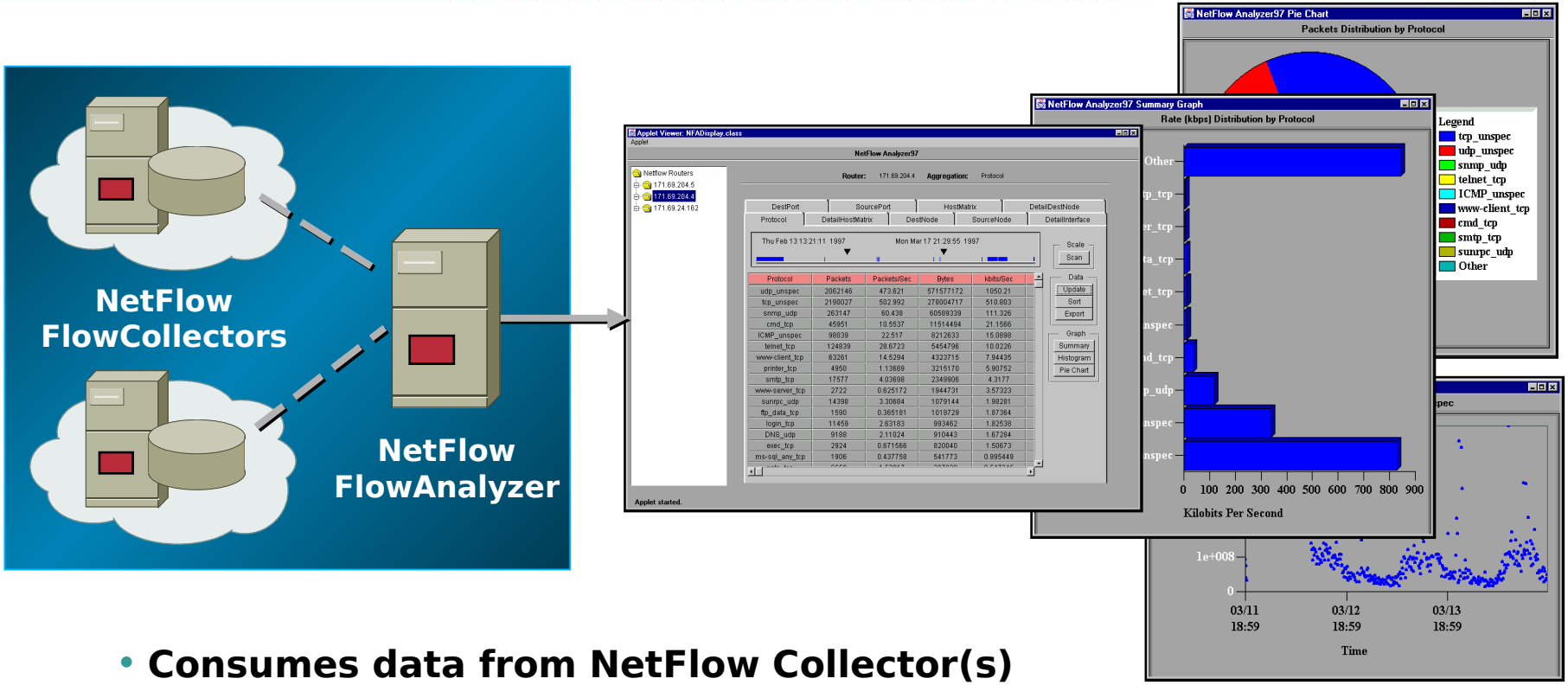
Network Data Analyzer



- **Consumes data from NetFlow Collector(s)**
- **Graphical display of NetFlow data**
- **Time-based analysis and data sorting**
- **Histograms, bar charts, and pie charts**
- **Spreadsheet data export**

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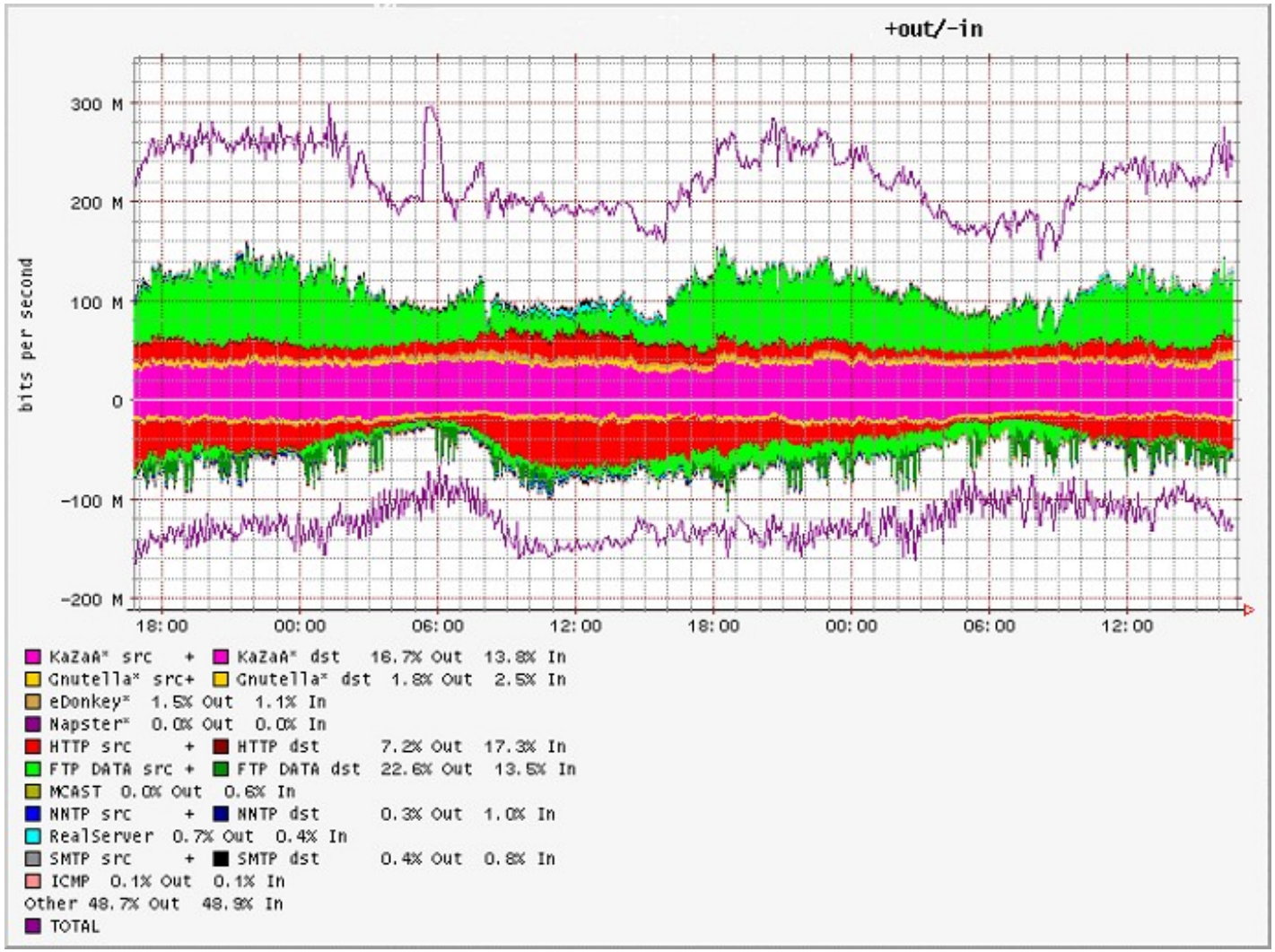
Flow Scan



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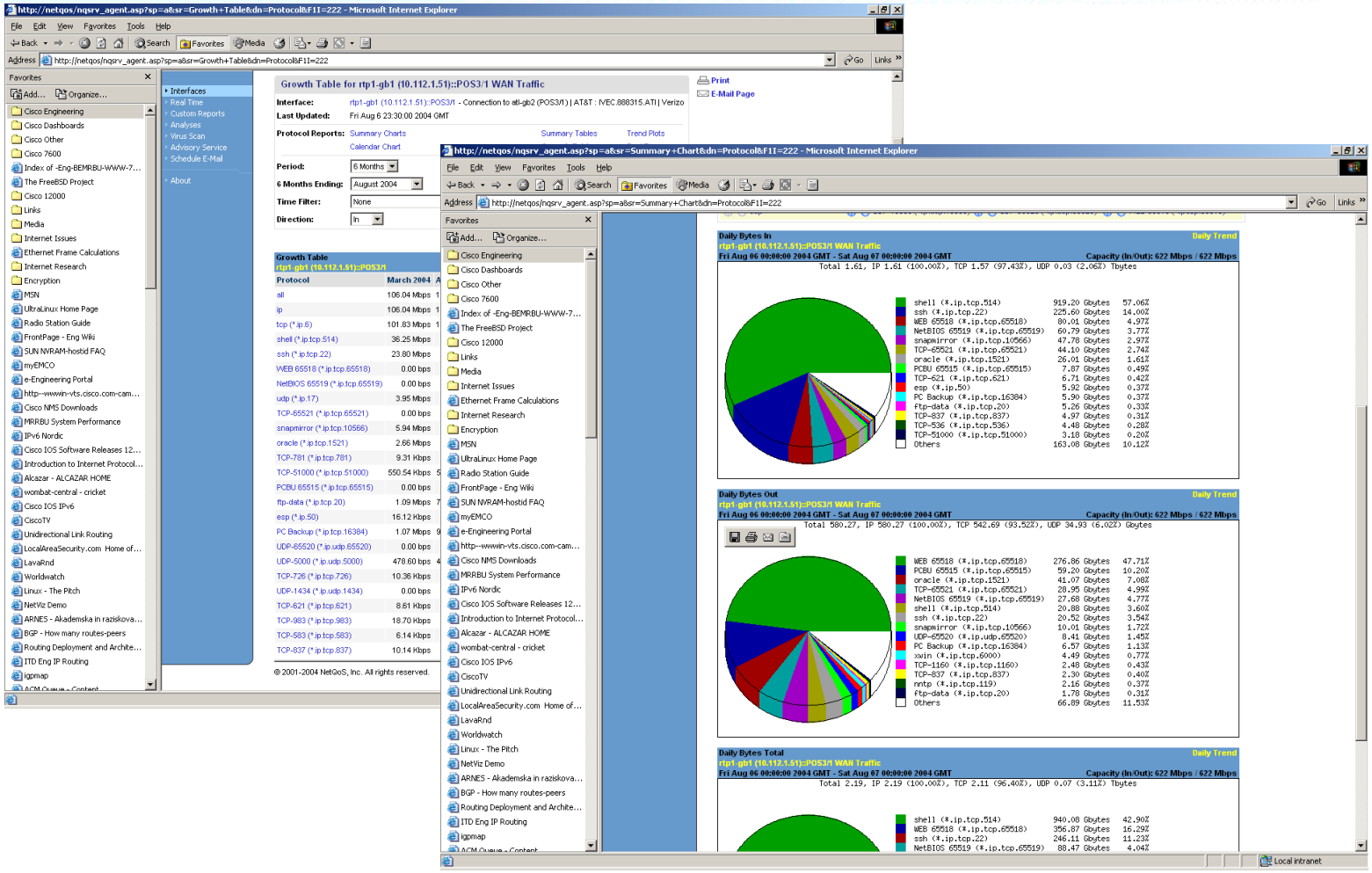
Monitoring using Netflow and SNMP



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Conclusion

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Conclusion

- **Instrument the network for troubleshooting performance problems**
- **Establish baselines of acceptable performance for different applications**
- **Installing monitoring tools, “is not a install and forget task”.**
- **THINK about what your monitoring, and determine if it will provide you the information to troubleshoot performance problems**

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